SHOCK MODELS OF TIME VARIABILITY AND SUPERLUMINAL MOTION IN COMPACT EXTRAGALACTIC RADIO SOURCES

Philip A. Hughes, Hugh D. Aller & Margo F. Aller
Radio Astronomy Observatory
Dennison Building
University of Michigan
Ann Arbor, Michigan 48109-1090

Following the success of a simple shock model for outbursts in BL Lacertae and 3C 279 (see Aller, Aller & Hughes, this meeting) we have constructed computer codes to study in detail the radiation from shocked, relativistic jets. These codes compute the transfer of synchrotron radiation, accounting for polarized emission and absorption, rotation, and mode conversion for a turbulent collimated flow with one or more shocks propagating parallel to the jet axis. We present results for a flow that evolves adiabatically, with the turbulence represented by a random component to the magnetic field within each computational cell, and with the shocks prescribed analytically following Königl (Phys. Fluids, 23, 1083, 1980). From the evolution of the total and polarized fluxes as a function of frequency, and from the corresponding projection of the source structure on the plane of the sky, we see that this type of model

a. is capable of explaining the variability of compact radio sources - see Aller, Aller & Hughes, this meeting,
b. highlights the care needed when interpreting VLBI maps, in that
   i) the component separations are frequency dependent (see Fig. 1)
   ii) the 'core' is not always the brightest component (see Fig. 1)
   iii) the Doppler boosting factor of the shocked flow is not directly related to the Lorentz factor derived from the apparent superluminal motion of a component
   iv) a multiplicity of components can give rise to both apparent contractions and accelerations,
c. clearly shows the link between time variability of compact sources and evolving VLBI structure, and suggests that both may be understood in terms of weak shocks that tap a small fraction of a jet's flow energy,
d. enables us to probe the physical conditions of the flow and the ambient material.

This work was supported in part by NSF Grant AST-8501093.

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 81–82.

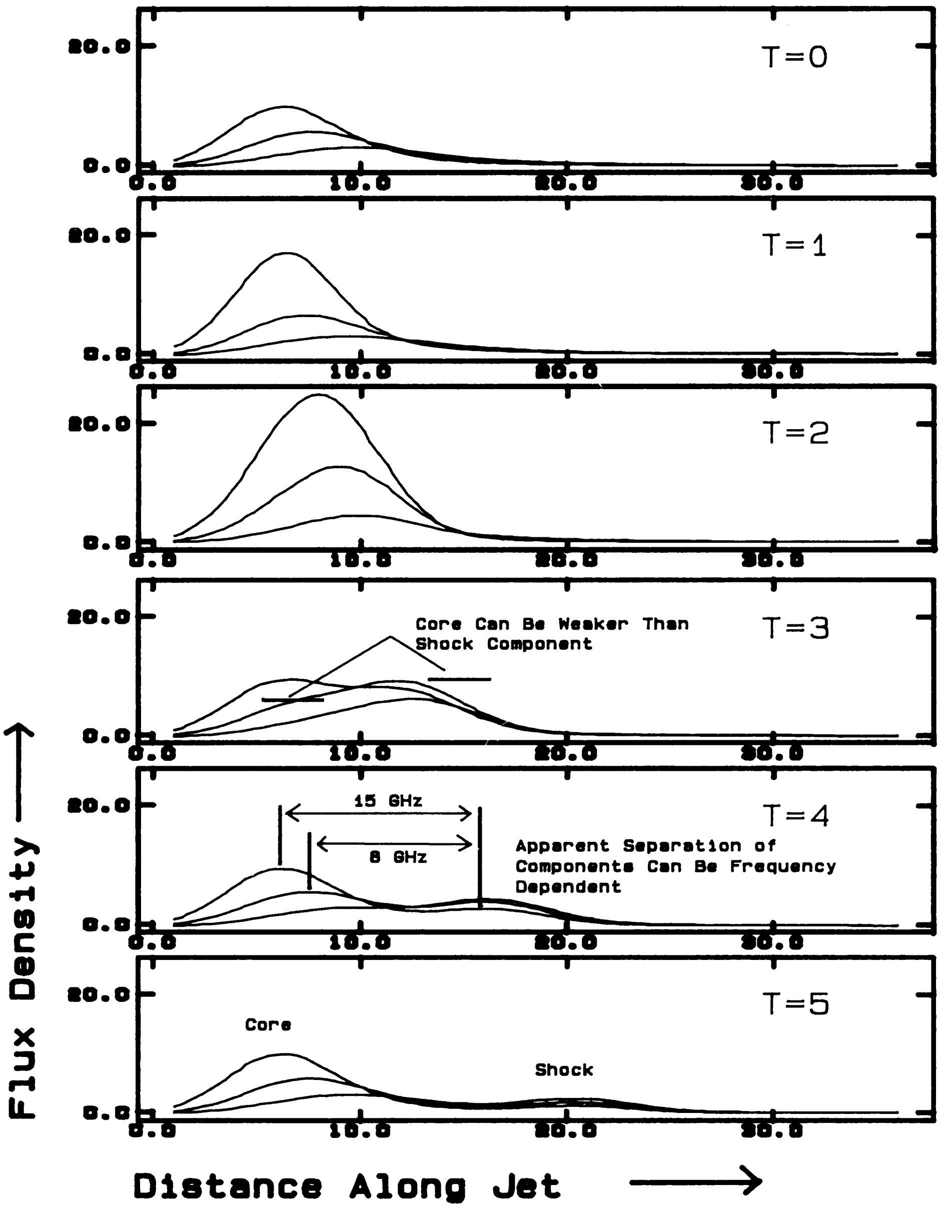

Figure 1. The brightness profiles for a shocked jet showing that the separation between core and shock component is frequency dependent and that the core can be weaker than the shock component. The top panel shows the quiescent jet, and the shock passes through the $\tau = 1$ surface at $T \approx 2$. The model has been convolved with an 'instrumental beam' that is three units HPBW.

https://doi.org/10.1017/S0074180900134023 Published online by Cambridge University Press